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ABSTRACT

This booklet describes Project 2061 and the strategies and tools for the improvement of education. It is divided into five sections: (1) Clear and Specific Learning Goals, which explains scientific literacy and defines the benchmarks for science literacy; (2) Preparation and Support for Teachers, which explains Project 2061 professional development programs and lists resources for science literacy; (3) Textbook and Test Alignment, which explains the steps of curriculum material analysis according to Project 2061; (4) K-12 Curriculum Coherence, which discusses strategies and techniques for aligning the entire curriculum to the standards; and (5) Community-wide Commitment, which explains the blueprint of the reform movement. (YDS)

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Project 2061

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SCIENCE LITERACY FOR A CHANGING FUTURE

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American Association for the Advancement of Science

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
Founded in 1848, the American Association for the Advancement of Science is the world's largest federation of scientific and engineering societies, with nearly 300 affiliate organizations. In addition, AAAS counts more than 146,000 scientists, engineers, science educators, policy makers, and interested citizens among its individual members, making it the largest general scientific organization in the world. AAAS's goals are to further the work of scientists; facilitate cooperation among them; foster scientific freedom and responsibility; improve the effectiveness of science in the promotion of human welfare; advance education in science; and increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

The AAAS wishes to express its gratitude to the following for their generous support of Project 2061:

Carnegie Corporation of New York
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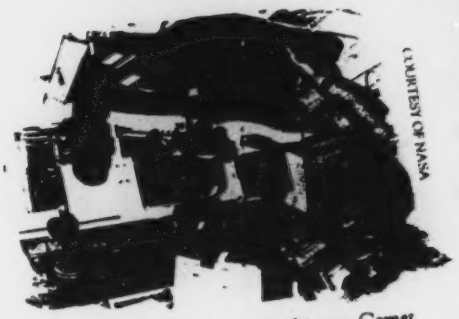

Astronaut George Nelson working on Comet Halley Active Monitoring Program in 1986.

I was lucky to be in school during the years right after the Sputnik launch when America vied with the U.S.S.R. to reach the moon. Spurred on by the space race, innovative programs in science and mathematics were widely available for students and teachers alike. I dreamt of becoming an astronomer and maybe even traveling in space. My great luck in fulfilling that dream on three space shuttle missions was certainly influenced by the science and mathematics training I received.

Today's students are not so lucky. After the moon walk, America's focus turned away from science and mathematics education. The effects are still being felt. Despite some gains in test scores and other measures, many of our children—even those at the top of their class—will leave high school unable to meet the scientific and technological challenges of the 21st century. If we are to be a prosperous, just, and secure nation, this must change.

Washington, D.C., school children join Nelson in AAAS's Cabot Teaching Laboratory.

For the past 13 years, Project 2061 of the American Association for the Advancement of Science has worked to reform K-12 education so that *all* students are literate in science, mathematics, and technology when they graduate from high school. To achieve this, we must drastically reduce the amount of extraneous material covered in classrooms and focus on the key science, mathematics, and technology concepts that an adult in the 21st century needs to know. Under the inspired direction of Dr. F. James Rutherford, Project 2061 outlined such learning goals in its groundbreaking publications *Science for All Americans* and *Benchmarks for Science Literacy*. After I left NASA to begin teaching science, these books helped convince me of the merit of Project 2061's reform efforts. I jumped at the chance to join the staff in 1996 when Jim asked me to become deputy director. I was honored to become Project 2061's director earlier this year when Jim moved into his new role as education advisor at AAAS.

As I see it, Project 2061 is centered around key elements that must be achieved to bring about meaningful, lasting education reform. We need clear and specific learning goals for all students, and teachers who have the preparation and support to help students achieve those goals. Textbooks and assessments must align with learning goals and fit into a coherent, purposefully designed K-12 curriculum. Finally, we need communities that understand and are committed to long-term education reform.

In the following pages you can find out more about Project 2061 and our strategies and tools for improving education. We are very excited about our newest initiative, Project 2061 Professional Development Programs, which will enable us to provide benchmarks-based training to educators across America. And we hope that our latest publication, *Blueprints for Reform*, will stimulate much needed dialogue about systemic education reform.

We welcome your feedback and look forward to hearing your ideas on how we can work together more effectively on behalf of America's children.

Sincerely,

George D. Nelson

George D. Nelson
Director, Project 2061

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CLEAR AND SPECIFIC LEARNING GOALS

IN JUNE 1985, THE YEAR HALLEY'S COMET SOARED ACROSS THE SKY, THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (AAAS) CREATED A NEW LONG-TERM K-12 SCIENCE, MATHEMATICS, AND TECHNOLOGY EDUCATION REFORM INITIATIVE, PROJECT 2061. THE NAME EMBODIED THE IDEA THAT EDUCATION IS FOR A LIFETIME—MANY CHILDREN BORN IN 1985 (AND STARTING THE SEVENTH GRADE IN 1998) WOULD STILL BE ALIVE WHEN THE COMET RETURNED IN 2061. PROJECT 2061'S MANDATE WAS TO TRANSFORM EDUCATION IN AMERICA SO THAT ALL STUDENTS WOULD BE PREPARED TO LIVE INTERESTING, RESPONSIBLE LIVES DURING THIS 76-YEAR SPAN OF ACCELERATING SCIENTIFIC AND TECHNOLOGICAL CHANGE.

Science for All Americans

Project 2061's first step was to set out recommendations for what all students should know and be able to do in science, mathematics, and technology by the time they graduate from high school. Five expert panels—whose members came from the biological and health sciences; social and behavioral sciences; physical and information sciences and engineering; mathematics; and technology—were convened to determine the concepts and skills most crucial to science literacy. Their recommendations were integrated into *Science for All Americans*, Project 2061's 1989 landmark document that defined science literacy and laid the groundwork for the subsequent science standards movement.

What is Science Literacy?

Science for All Americans defines a science literate person as one who

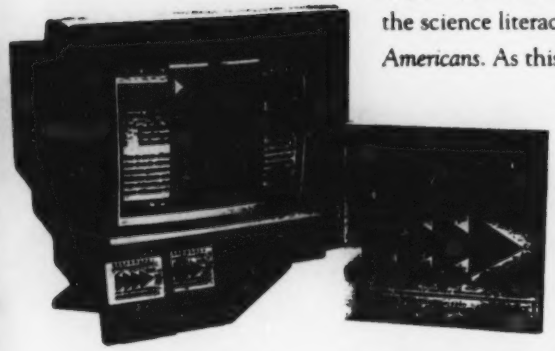
- is familiar with the natural world.
- understands some of the key concepts and principles of science.
- has a capacity for scientific ways of thinking.
- is aware of some of the important ways in which mathematics, technology, and science depend upon one another.
- knows that science, mathematics, and technology are human enterprises, and what that implies about their strengths and limitations.
- is able to use scientific knowledge and ways of thinking for personal and social purposes.

"This pioneering effort has profound implications for the future of our nation and, indeed, of the world."

David A. Hamburg
President (1979-1997), Carnegie Corporation of New York

Benchmarks for Science Literacy

In 1989 Project 2061 formed partnerships with six school-district teams that represented a cross-section of America's diverse public school sys-



"This publication is another milestone in the longstanding effort of Project 2061 to improve the teaching and learning of science for all Americans."

Bruce Alberts
President, National Academy of Sciences

tem. The teams, located in school-district centers in San Antonio, San Francisco, San Diego, Philadelphia, rural Georgia, and suburban McFarland, Wisconsin, were charged with designing curriculum models that would address the science literacy goals in *Science for All Americans*. As this work progressed, the teams soon realized that an essential, prior, and difficult task was to formulate learning goals for specific grade levels along the way to science literacy. Their work, supplemented with input by consultants and Project 2061 staff and additional education research on student learning, was published in *Benchmarks for Science Literacy* in 1993.

Benchmarks Defined

Benchmarks for Science Literacy translates the science literacy goals in *Science for All Americans* into learning goals or benchmarks for grades K-2, 3-5, 6-8, and 9-12. It is available in print form, on computer disk (Windows and Macintosh) and on-line at http://project2061.aaas.org.

- *Benchmarks* does not advocate any particular curriculum design. It is a tool to be used by educators in designing a curriculum that makes sense to them and meets the science literacy goals outlined in *Science for All Americans*.
- *Benchmarks* describes levels of understanding and ability that all students are expected to reach on the way to becoming science literate. Though this is not the case today, most students should be able to learn well beyond the benchmarks.
- *Benchmarks* concentrates on the common core of learning that contributes to the science literacy of all students, regardless of gender, socio-economic status, or ethnic background.
- *Benchmarks* avoids technical language for its own sake.
- *Benchmarks* is informed by research on students' understanding and learning, which bears significantly on the selection and grade placement of the benchmarks.

Benchmarks is a companion tool to be used with *Science for All Americans*, not a substitute for it. *Science for All Americans* emphasizes cogency and connectedness and *Benchmarks* emphasizes analysis of the *Science for All Americans* story into components and their sequence. Both works include specific recommendations in the following areas:

The Nature of Science focuses on three principal subjects: the scientific world view, scientific methods of inquiry, and the nature of the scientific enterprise.

The Nature of Mathematics describes the creative processes involved in both theoretical and applied mathematics.

The Nature of Technology considers how technology extends our abilities to change the world and the considerations necessary for its prudent use.

The Physical Setting describes basic knowledge about the content and structure of the universe (on astronomical, terrestrial, and submicroscopic levels) and the physical principles on which the universe seems to run.

The Living Environment delineates basic ideas about how living things function and how they interact with one another and their environment.

The Human Organism characterizes living systems through a focus on the human species as one that is in some ways like other living things and in some ways unique.

Human Society considers scientific principles of individual and group behavior, social organization, and the process of social change.

The Designed World reviews principles of how the world can be shaped and controlled in some key areas of technology.

The Mathematical World gives an account of basic mathematical ideas that together play a key role in almost all human endeavors.

Historical Perspectives illustrates the science enterprise with 10 historical examples of exceptional significance in the development of science.

Common Themes presents general concepts that cut across science, mathematics, and technology.

Habits of Mind sketches the attitudes, skills, and ways of thinking that are essential to science literacy.

Leading the Way in Education Reform

With nearly 133,000 copies of *Science for All Americans* and 97,000 copies of *Benchmarks* sold in the United States and throughout the world, Project 2061 has had a major influence on the standards movement and science education reform in America. A large-scale study released in 1996 by the Organisation of Economic Cooperation and Development (OECD) on innovations in science education around the world stated that Project 2061 was the "single most visible attempt at science education reform in American history." SRI International, in a year-long evaluation of the influence of *Science for All Americans* and *Benchmarks for Science Literacy*, stated that Project 2061 has "changed the national climate for science education reform."

State, National, and Worldwide Influence

The National Research Council drew heavily on *Science for All Americans* and *Benchmarks for Science Literacy* when writing the content standards in its *National Science Education Standards* (*NSES*) released in 1996 and acknowledges Project 2061 in the *NSES* introduction:

> *The many individuals who developed the content standards sections of the* National Science Education Standards *made independent use and interpretation of the statements of what all students should know and be able to do that are published in* Science for All Americans *and* Benchmarks for Science Literacy. *The National Research Council of the National Academy of Sciences gratefully acknowledges its indebtedness to the seminal work by the American Association for the Advancement of Science's Project 2061 and believes that use of* Benchmarks for Science Literacy *by state framework committees, school and school-district curriculum committees, and developers of instructional and assessment materials complies fully with the spirit of the content standards (National Research Council, 1996).*

Project 2061 Principles of Reform

The 1983 report A Nation at Risk: The Imperative for Educational Reform, *released by the National Commission on Excellence in Education, warned of a national education crisis in America and urged reform of the entire system. Dozens of subsequent reports supported the Commission's conclusions and also linked the decline of the United States as an economic and technological world leader to the failing education system. Consistently poor scores of American students on such achievement tests as the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS) have been further cause for alarm. Since 1985, Project 2061 has been working to address this education crisis by designing tools for educators to use to develop their own local curriculum keyed to national learning goals. Project 2061's work in developing such tools has been guided by the following principles of reform:*

- ***The first priority of science education*** *is basic science literacy for all students, including those in groups that have traditionally been served poorly by science education, so that as adults they can participate fully in a world that is increasingly being shaped by science and technology.*
- ***Education for universal science literacy will,*** *in addition to enriching everyone's life, create a larger and more diverse pool of students who are able to pursue further education in scientific fields and are motivated to do so.*
- ***Science literacy consists of knowledge*** *of certain important scientific facts, concepts, theories, and applications; the exercise of scientific habits of mind; and an understanding of the nature of science, its connections to mathematics and technology, its impact on individuals, and its role in society.*
- ***For students to have the time needed*** *to acquire essential knowledge and skills of science literacy, the sheer amount of material that today's science curriculum tries to cover must be significantly reduced.*
- ***Effective education for science literacy*** *requires that every student be frequently and actively involved in exploring nature in ways that resemble how scientists themselves go about their work.*

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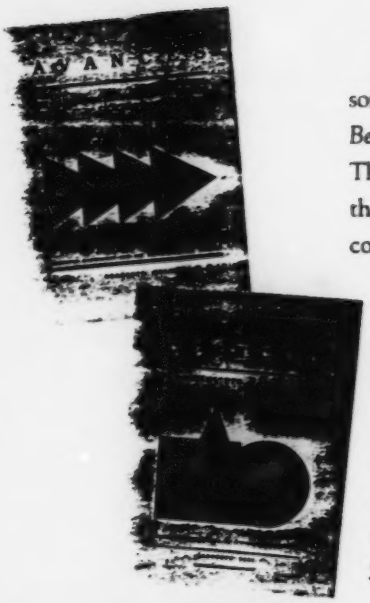


Project 2061 has prepared a detailed comparison of the content portion of the *NSES* with *Benchmarks* and has found substantial overlap. The National Research Council has stated that the two documents share about 90% of the same content recommendations. This similarity testifies to a strong consensus among experts on what students should know and be able to do in science. Because Project 2061's learning goals encompass science, social science, mathematics, and technology, there is also considerable congruity between *Benchmarks for Science Literacy* and two other sets of national standards: *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989) and *Curriculum Standards for Social Studies* (National Council for Social Studies, 1994). A detailed comparison of *Benchmarks* to all three national standards documents can be found on Project 2061's CD-ROM tool *Resources for Science Literacy: Professional Development*.

A survey conducted by SRI International of 43 state curriculum documents revealed that many of them cite Project 2061 and its publications as key sources in their bibliographies, quote directly from Project 2061 publications to describe their vision of science literacy or rationale for reform, or organize their own recommendations according to topics in *Science for All Americans* and *Benchmarks*. Some, like Indiana, even adopt Project 2061 benchmarks verbatim.

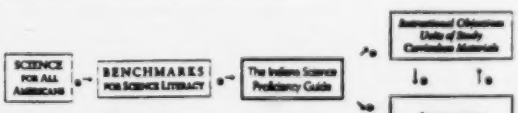
On the international front, *Science for All Americans* and *Benchmarks for Science Literacy* have been translated into Spanish, and Project 2061 is exploring the possibility of Japanese and Chinese translations. Countries around the world have sponsored conferences on these works including France, Spain, Taiwan, and Hong Kong.

Project 2061 Influences the States

In a recent study of state science standards, the Thomas B. Fordham Foundation gave its highest rating to Indiana, a state which used **Benchmarks for Science Literacy** ***verbatim as its science standards.*** **The Indiana Science Proficiency Guide** *highlights the state's indebtedness to Project 2061 in its introduction:* ***"Without*** **Benchmarks,** *the proficiencies, as found in this book, would not exist."*

Dr. Suellen Reed, Indiana's Superintendent of Public Instruction stated, ***"By selecting*** **Benchmarks for Science Literacy** *as the foundation for our guide, the committee that created our proficiencies ensured that we would have world class standards in science."*

Of the six A-rated states in the Fordham study, five of them—Arizona, California, Indiana, New Jersey, and Rhode Island—have recognized Project 2061 as a major influence on their science standards.



The Indiana Science Proficiency Guide, 1997

LOOKING AHEAD. . .

Updated and revised editions of *Science for All Americans* and *Benchmarks for Science Literacy*. Nearly a decade of progress in science, mathematics, and technology requires a new look at science literacy. Moreover, intensive examination of these documents in building curriculum frameworks and evaluating instructional materials has revealed the need for some refinement of benchmark connections, meaning, and grade placement. Revised editions of these volumes will incorporate advances in what is known about effective teaching and learning and will synthesize the best of national and state standards and benchmarks.

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PREPARATION AND SUPPORT FOR TEACHERS

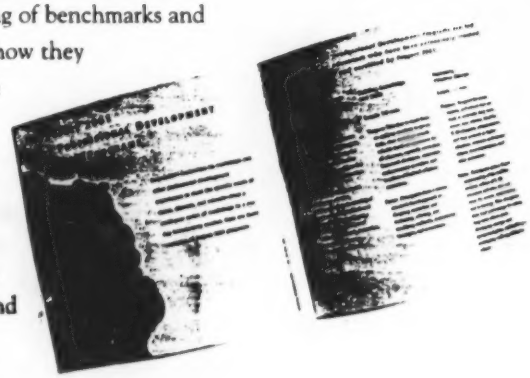
PROJECT 2061 GAVE ITS FIRST PROFESSIONAL DEVELOPMENT WORKSHOP FOR TEACHERS IN JUNE 1994. WORKSHOP MODULES WERE FURTHER DEVELOPED AND TESTED BY PROJECT 2061 STAFF, CONSULTANTS, AND SCHOOL-DISTRICT TEAM LEADERS, AND SOON PROJECT 2061 WAS FILLING OVER 150 WORKSHOP REQUESTS EACH YEAR. NOW, WITH A THREE-YEAR, $2 MILLION START-UP GRANT FROM THE PEW CHARITABLE TRUSTS, PROJECT 2061 HAS LAUNCHED A NEW STAFF DEVELOPMENT ENTERPRISE.

Project 2061 Professional Development Programs

Rather than take a "one size fits all" approach, Project 2061 Professional Development Programs are custom-tailored to meet the needs of individual school districts and schools. The enterprise will eventually become self-sustaining, allowing Project 2061 to be more actively engaged with teachers, administrators, school board members, curriculum materials developers, parents, and community members who want to help students achieve literacy in science, mathematics, and technology. School districts can utilize training funds already available from federal, state, and local sources, and Project 2061 will help districts find additional funding from corporate and other community sources so that staff development can be ongoing.

Participants in the workshops will achieve the following: 1) Understand what benchmarks and standards expect students to know and be able to do in science, mathematics, and technology, 2) Design more coherent curricula and select more effective learning materials, 3) Teach with more purpose and skill, 4) Learn more about the subjects they teach, and 5) Connect with others who are involved in education reform. Teachers will work with Project 2061's print and electronic tools, with other state and national standards documents, and with actual curriculum materials and classroom resources. Workshops fall into three categories:

- **Introducing standards and benchmarks.** These one- to three-day workshops introduce educators to standards-based reform and what it means for classroom practice. Through hands-on and small-group activities, participants study the meaning of benchmarks and standards and explore how they can be used to improve instruction, analyze state or district standards, and select curriculum materials aligned with standards.



- **Building knowledge and skills.** These one- to three-week workshops give participants a deeper understanding of what and how to teach to meet standards. Participants learn and practice new techniques for evaluating curriculum materials, instructional strategies, and assessment instruments for their alignment to content stan-

dards and effectiveness criteria. Participants examine cognitive research, consider its applications to classroom practice, and reflect on the need for taking an evidence-based approach to any evaluation task.

- **Promoting long-term partnerships.** Some states and districts are ready to undertake more system-wide reforms involving partnerships with higher education institutions, parent and community organizations, corporations, museums and science centers, and so on. These workshops scheduled over a period of years provide customized technical assistance, leadership training, and consulting services over time. They help districts and schools take the first steps toward purposefully redesigning their entire K-12 curriculum around standards and strengthening their partnerships by setting long-term reform goals, developing strategic and operational plans, and building a community-wide capacity for reform.

"Resources is very user-friendly."

Teachers Clearinghouse for Science and Society Education

Philadelphia Benefits from Long-Term Training

Through long-term collaboration, Project 2061 helps school districts build their capacity for systemic reform. For three years, K-12 teachers and administrators in Philadelphia met with Project 2061 staff for up to a month every summer and once a week during the school year. Collaboration continued as these educators joined with Project 2061 in providing workshops to other Philadelphia teachers. Their efforts paid off. In its 1997 report on the city's reform efforts, the Philadelphia Education Fund described the significant impact of Project 2061's professional development: "...the 2061 teachers brought important perspectives and expertise to the District's efforts: knowledge that standards creation can be frustrating and takes time; experience in articulating work across all grade levels; skill in analyzing textbooks and materials to see if they are standards-driven; experience with constructivist teaching methods; and a commitment to addressing diversity."

Resources for Science Literacy: Professional Development

In 1997 Project 2061 released *Resources for Science Literacy: Professional Development*, a CD-ROM tool that enables teachers, higher education faculty, and school district curriculum and professional development specialists to make more effective use of specific learning goals like benchmarks and national and state standards. This CD-ROM, used in many of Project 2061's workshops, offers an array of resources including the full text of *Science for All Americans*. A companion print volume introduces users to the CD-ROM, which includes the following:

- **Science Trade Books** cites over 120 books for a general audience on many areas of science, technology, and mathematics. Each entry includes full bibliographic information, reviews, and other descriptive data. Users can search the database by topics found in *Science for All Americans* to compile customized reading lists.
- **College Courses** describes 15 college courses offered at ten colleges and universities that provide examples and guidelines for designing courses around concepts from *Science for All Americans*.
- **Comparisons of Benchmarks to National Standards** shows how Project 2061's benchmarks relate to national content standards in science, mathematics, and social studies. Educators can use this component to compare their own state or district level guidelines to the national content recommendations.
- **Cognitive Research** introduces users to research literature that will familiarize them with some of the difficulties students may have in learning many of the topics in *Science for All Americans* and *Benchmarks*. In addition to *Benchmarks*' chapter 15, "The Research Base," and its bibliography of over 300 references, there are descriptions of more than

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100 articles, reports, and videos related to how students learn science literacy concepts at various ages.

- **Project 2061 Workshop Guide** includes a rich collection of materials that can be used to design and conduct a variety of workshops to help participants understand science literacy goals and to use them to improve curriculum, instruction, and assessment.

The *Resources for Science Literacy: Professional Development* CD-ROM is currently being updated so it can be connected to the Internet. This new Web-CD will provide the benefits of a stand-alone electronic tool with search and zoom capabilities as well as pointers to timely and relevant information on the World Wide Web.

New Models for Teacher Preparation

With funding from the John D. and Catherine T. MacArthur Foundation, Project 2061 is working closely with university/school-district collaboratives in Maryland and Colorado to help them develop model programs for preparing K-12 teachers and supporting them during their first years in the classroom. The Maryland team involves education faculty from Towson University, teachers and administrators from the Baltimore County School District, and several state policy makers. In Colorado, teams are made up of representatives from six universities along with master science teachers from partner schools throughout the state. Over the next two years, the teams at both sites will be developing new college science courses around ideas from *Science for All Americans*, incorporating the study of *Benchmarks for Science Literacy* into teaching-methods courses, and supporting the professional development of a cadre of experienced K-12 teachers to serve as mentors to new teachers.

Preparing Future Science Education Leaders

NASA has provided funding to Project 2061 to plan a program that will proactively develop science education leaders who can advance the ideas and processes of standards-based reform for all students. The program, open to graduate students, faculty, and administrators, will be run jointly by AAAS's Project 2061 and its Directorate for Education and Human Resources. Science education reform leaders from across the country are joining with Project 2061 to outline components of the program, which will include research, mentoring, networking, and developing expertise through fieldwork in schools and communities.

Project 2061 Workshops Create Leaders in the Classroom

Sue Harsin's attendance at a week-long workshop on Project 2061 tools enabled her to go back to her Banks School District in Oregon and take on the role of a "leader in science." In presentations to elementary, junior high, and high school science teachers, she keeps her colleagues up to date on Project 2061's tools. As chairman of her district's science committee, Harsin is guiding the development of a new science curriculum. She described how Project 2061 has also changed her work in the classroom: "The workshop last summer opened my eyes to really looking at each science activity that I do. I think about the age appropriateness of each lesson by referring to Benchmarks for Science Literacy *and using our state benchmarks and our district curriculum. I appreciate the research behind* Benchmarks, *which makes me feel confident that what I'm teaching in science is what my second- and third-graders can understand and retain. The resources I choose to use are geared to the grades I am teaching, and I am confident that I am more effective as a science teacher than I was in past years."*

LOOKING AHEAD. . .

Updated version of *Resources for Science Literacy: Professional Development*: A revised version of the CD-ROM scheduled for release in the year 2000 will include extended databases and new workshops and college courses developed through Project 2061's work with teacher educators in Maryland and Colorado.

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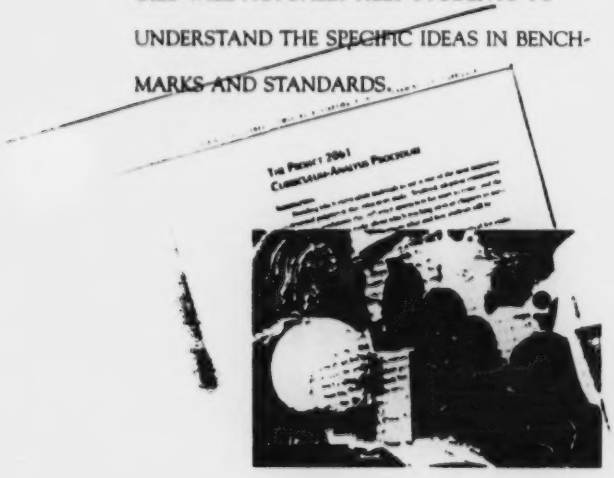
TEXTBOOK AND TEST ALIGNMENT

FOR THE PAST THREE YEARS, WITH FUNDING FROM THE NATIONAL SCIENCE FOUNDATION AND INPUT FROM MORE THAN ONE HUNDRED K-12 TEACHERS, TEACHER EDUCATORS, MATERIALS DEVELOPERS, AND COGNITIVE SCIENTISTS NATIONWIDE, PROJECT 2061 HAS DEVELOPED AND FIELD-TESTED A RIGOROUS PROCEDURE FOR ANALYZING SCIENCE AND MATHEMATICS CURRICULUM MATERIALS. NUMEROUS EDUCATORS HAVE BEEN TRAINED TO USE THIS PROCEDURE, WHICH ANALYZES NOT ONLY A TEXTBOOK'S CONTENT BUT ALSO ITS INSTRUCTIONAL STRATEGIES TO SEE WHETHER THE STRATEGIES WILL ACTUALLY HELP STUDENTS TO UNDERSTAND THE SPECIFIC IDEAS IN BENCHMARKS AND STANDARDS.



Project 2061's Curriculum Materials Analysis Procedure

The procedure requires four critical steps:

Review the Material. A preliminary inspection of the material determines whether it merits further analysis. If so, specific learning goals or benchmarks are identified to be the focus of the analysis.

Analyze Content. Examine the material's content in detail for its alignment to the specified learning goals. If this step reveals a match, the analysis continues.

Evaluate Instructional Strategy. Using criteria derived from research on student learning and on characteristics of effective teaching, estimate how well a material's instructional strategies support student learning of the ideas and skills for which there is a content match.

Summarize Findings. Describe and summarize evidence showing how well the material's content and its instructional strategies relate to the learning goals and draw conclusions on the material's strengths and weaknesses.

Project 2061's procedure has gained wide endorsement in the education community. The U.S. Office of Education Research and Improvement (OERI) invited Project 2061 to explain its analysis procedure in the resource kit, *Attaining Excellence: TIMSS as a Starting Point to Examine U.S. Curricula*, which was distributed by the Department of Education to school districts around the country. OERI's Expert Panel for Mathematics and Science Literacy used Project 2061's procedure and advice when developing its own curriculum analysis procedure for identifying promising and exemplary K-12 programs. The National Research Council has invited Project 2061's curriculum director to serve on a committee that will recommend criteria and procedures for selecting instructional materials that align

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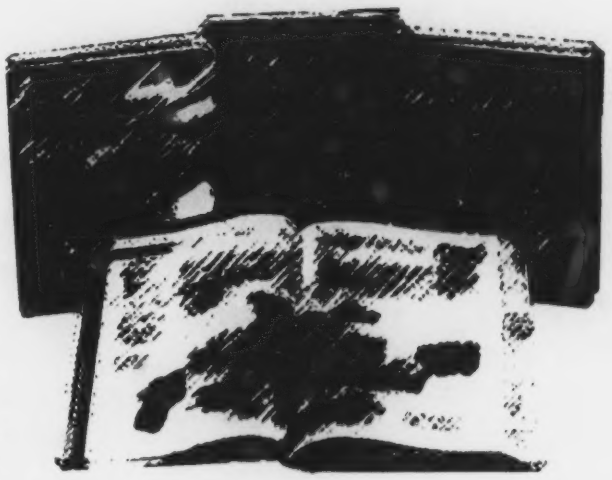
with standards. Additionally, NASA has provided funding to Project 2061 to train Goddard Space Flight Center managers and curriculum developers/reviewers who are involved in K-12 educational outreach to use Project 2061's procedure. This training will lead to ongoing review of NASA curriculum support materials for their alignment with benchmarks and standards.

Resources for Science Literacy: Curriculum Materials Evaluation

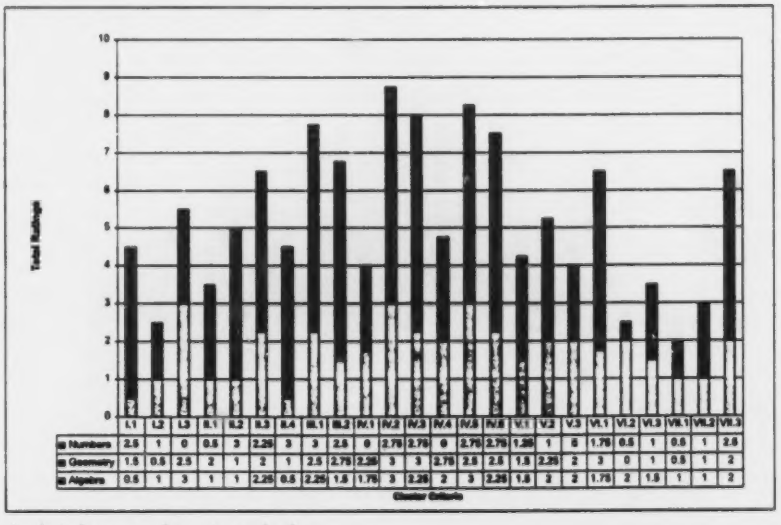
The forthcoming book and CD-ROM, *Resources for Science Literacy: Curriculum Materials Evaluation*, will contain a detailed description of Project 2061's curriculum materials evaluation procedure and its uses, along with the rationale and an overview of the research supporting this analytical approach. It will also contain:

- Explanations of criteria for evaluating materials and examples, both positive and negative, illustrating how to apply the criteria to a variety of K-12 science and mathematics curriculum materials.
- Commentary on important issues related to curriculum evaluation in general and Project 2061's analysis procedure in particular.
- A summary of cognitive research—including and supplementing that in *Benchmarks*—relevant to teaching and learning specific ideas and skills.
- A small collection of evaluated materials, including bibliographic information, summaries of activities, descriptions of each material's intended audience and goals, evaluation reports, and samples from the instructional materials themselves.
- Tutorials and workshop plans for applying the procedure in different settings for a variety of purposes.

Curriculum Materials Evaluation Database



The rigor of Project 2061's curriculum analysis procedure makes it reliable from one reviewer to the next but too time-consuming to be widely practical for the average school or district to use. Nevertheless, anyone with responsibility for evaluating or selecting curriculum materials will want to take advantage of the critical information the procedure yields. With funding from the Carnegie Corporation of New York, Project 2061 is training independent teams of educators, scientists, and mathematicians to analyze curriculum materials and prepare detailed reports that will be available in print



Analysis data on mathematics textbooks.

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and on-line. Project 2061's Curriculum Materials Evaluation Database will offer teachers objective, credible, and easy-to-use information about how well textbooks can support students learning benchmarks and standards. The teams are analyzing both newly developed and widely used middle-school science and mathematics textbooks and, when additional funding is received, will progress to elementary and high school curriculum materials.

Influencing Textbook Development

From the beginning, Project 2061 envisioned that its curriculum materials analysis procedure would increase both the demand for materials that could help students achieve benchmarks and standards and the supply of such materials. Project 2061's workshops with not-for-profit curriculum developers have stimulated interest in tying instructional materials more closely to benchmarks and standards, and some commercial publishers have begun to incorporate Project 2061's benchmarks into their print and electronic products.

It may be that Project 2061's procedure will be more useful in designing new materials than in revising existing texts. Several curriculum materials developers have asked Project 2061 to support their grant proposals by agreeing to provide training in the procedure to author teams and to review early drafts.

Project 2061 Helps Philadelphia School District Choose Texts

Carolyn Minor, a science coordinator with Philadelphia's Urban Systemic Initiative, has attended numerous Project 2061 workshops and received extensive training in Project 2061's curriculum materials analysis procedure. This training has enabled her to assist Philadelphia's school district in analyzing current elementary textbooks to see if they match Philadelphia's standards (based on Benchmarks for Science Literacy*). Minor stated, "These workshops have helped me to make better choices about curriculum resources. I'm learning how to look at materials with a more critical eye. Surprisingly, much of what is currently available does not help students to achieve the understandings that are expressed in the benchmarks. I'm learning how to fix these materials, and how to look for new ones."*

LOOKING AHEAD. . .

Resources for Science and Mathematics Literacy: Assessment High-stakes tests have become a driving force for change in education, and it is imperative that they align well with national and state benchmarks and standards. Project 2061 is analyzing selected mathematics and science assessment tasks and exploring the development of a full-scale assessment analysis procedure, which would be taught in workshops, used to create an assessment database, and published in book and CD-ROM form.

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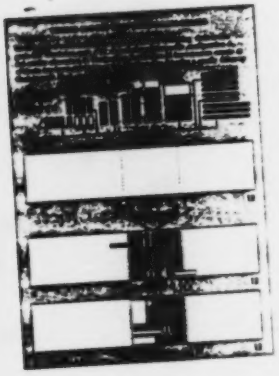
K-12 CURRICULUM COHERENCE

SCIENCE EDUCATION REFORM GOES BEYOND INDIVIDUAL CLASSROOMS OR INDIVIDUAL GRADES. FOR STUDENTS TO ACHIEVE SCIENCE LITERACY, THE ENTIRE K-12 CURRICULUM MUST BE REFORMED. THIS IS A MAJOR UNDERTAKING WORTHY OF THOUGHTFUL DESIGN RATHER THAN PIECEMEAL DECISIONS. PROJECT 2061 HAS DEVELOPED A NEW PRINT AND CD-ROM TOOL, *DESIGNS FOR SCIENCE LITERACY*, TO BE PUBLISHED IN EARLY 1999, WHICH DEALS SPECIFICALLY WITH STRATEGIES AND TECHNIQUES FOR ALIGNING THE ENTIRE K-12 CURRICULUM TO BENCHMARKS AND STANDARDS OR STATE AND LOCAL FRAMEWORKS.



Designs for Science Literacy

While upholding ambitious learning goals, *Designs* fosters the development of diverse curricula suited to the needs of individual schools, communities, and students by doing the following:

- Offering a conceptual framework—and a computer tool—that educators can use to apply general design principles to their work on the curriculum.
- Encouraging school systems to adopt a curriculum design process that centers on learning goals; engages as many stakeholders as possible; takes a systematic approach; and evaluates risks, benefits, and trade-offs.

- Helping curriculum designers to consider the science, mathematics, and technology components of the curriculum together and within the context of the K-12 curriculum.
- Describing how a curriculum might eventually be assembled from a pool of high-quality instructional blocks of various sizes from week-long units to year-long courses.
- Providing teacher educators with a resource for teaching the principles of curriculum analysis and design as an essential part of pre-service training.
- Enabling school districts to begin making changes in today's curriculum that will provide a foundation for the curriculum redesign of tomorrow. For example, *Designs*

Project 2061 Helps Baltimore School Streamline Curriculum

Teachers and supervisors from Timonium Elementary School in Baltimore attended a five-day Project 2061 workshop to learn how to restructure their K-5 science curriculum. Participants learned how to design and develop lessons with particular benchmarks in mind and used Project 2061's reform principle "less is more" to focus on fewer topics and cover them in more depth. They used Benchmarks for Science Literacy *and growth-of-understanding maps to see which learning goals were most important for students in grades K-5. Timonium Elementary School principal Kathy Volk commented, "Thinking about how learning occurs over time enabled us to eliminate topics that were too advanced or less relevant. While it took some time and effort to make the changes, our new streamlined curriculum is showing positive results. Our students now have more time to concentrate on key ideas and to learn them more thoroughly."*

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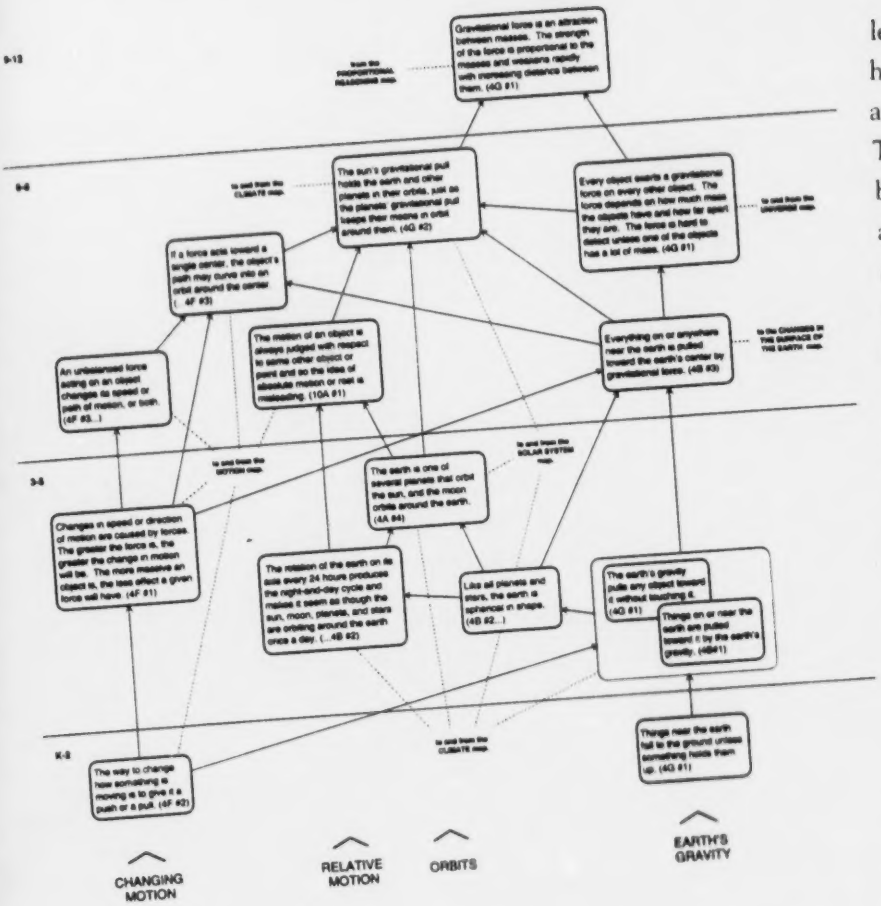

A growth-of-understanding map on gravity.

discusses how to build local professional capability, reduce the core content of the overstuffed curriculum, and enhance connections across subjects and grades.

Atlas of Science Literacy

An entire K-12 curriculum planned with the relationships among benchmarks in mind will provide a better paced and more coherent progression of subjects and courses. To help educators gain insight into the sequence and connections among K-12 benchmark ideas, Project 2061 is developing the *Atlas of Science Literacy*, a collection of conceptually linked maps that depict how students might grow in their understanding and skills toward particular science literacy goals. These maps display not only the sequence of benchmark ideas that lead to a literacy goal, but also the supporting connections across different areas of science, mathematics, and technology, and how ideas come together in more sophisticated understanding. The *Atlas* will give teachers a better sense of how their instruction fits into the larger picture of students' K-12 science education—where ideas are coming from and where they will lead next—and will provide the basis for discussions and collaboration among teachers at different grade levels and across subjects.

The *Atlas* will include approximately 50 maps depicting K-12 growth of understanding in a variety of science literacy topics including the water cycle, evolution and natural selection, structure of matter, and the flow of matter and energy in ecosystems. A Web-CD version will allow users to move conveniently between connected maps and will provide hypertext links that identify relevant research and other information.

LOOKING AHEAD. . .

System 61. This comprehensive software tool will incorporate, integrate, and update many of Project 2061's reform tools and supplement them with other valuable resources such as state and local standards and curriculum guidelines. To make Project 2061's tools as widely available as possible, System 61 will be accessible on CD-ROM and the World Wide Web.

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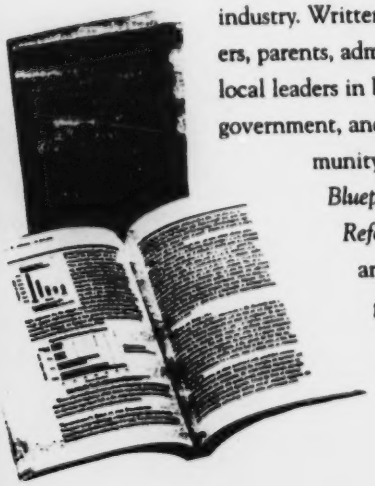
COMMUNITY-WIDE COMMITMENT

SERIOUS EFFORTS TO ACHIEVE LITERACY IN SCIENCE, MATHEMATICS, AND TECHNOLOGY FOR ALL STUDENTS MUST BE BASED ON AN UNDERSTANDING OF HOW DIFFERENT MEMBERS OF THE COMMUNITY—TEACHERS, PARENTS, UNIVERSITY FACULTY, AND BUSINESS AND INDUSTRY LEADERS—WORK TOGETHER IN THE EDUCATION SYSTEM. A NEW PUBLICATION FROM PROJECT 2061 OFFERS A USEFUL STARTING POINT FOR THIS KIND OF SYSTEMIC REFORM.

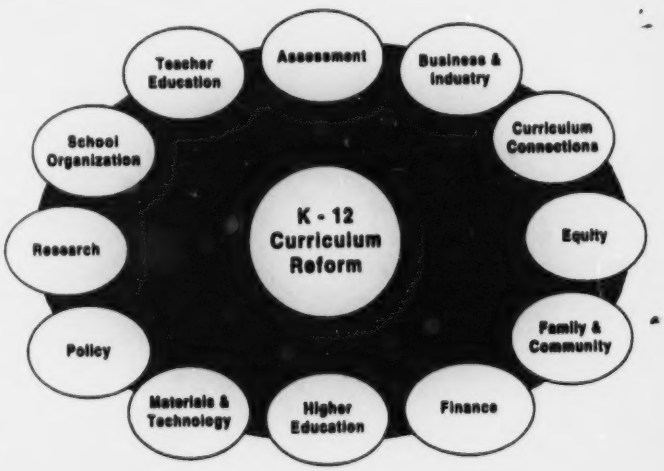
Blueprints for Reform

Project 2061's *Blueprints for Reform: Science, Mathematics, and Technology Education* presents summaries of reports written by teams of experts on 12 crucial areas of the K-12 education system that must work together and change to bring about education reform. The areas covered are equity, policy, finance, research, school organization, curriculum connections, materials and technology, assessment, teacher education, higher education, family and community, and business and industry. Written for teachers, parents, administrators, local leaders in business and government, and other community members, *Blueprints for Reform* provides an extensive guide to hundreds of related education resources, programs, and organizations and offers a focused starting point for exploring systemic educational reform. Project 2061 has made the publication available on its Web site at http://project2061.aaas.org and strives to continue the dialogue about reform through on-line discussion groups and monthly surveys on *Blueprints* chapters and topics.



Dialogue on Early Childhood Science, Mathematics, and Technology Education

Project 2061, with funding from the National Science Foundation, sponsored the Forum on Early Childhood Education in Science, Mathematics, and Technology in February 1998. One of the first meetings to seriously address the role of these areas in early childhood education, the forum was attended by more than 100 researchers, educators, and policymakers. Discussions centered on issues related to demographics, policy, professional development, cognitive development, curriculum, instruction, assessment, equity, and the role of parents and the community. To build on the dialogue started at the forum, Project 2061 is publishing a set of commissioned papers in book form and on-line at http://project2061.aaas.org.



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National Council on Science and Technology Education

Throughout its 13 years, Project 2061 has been advised by the National Council on Science and Technology Education, an advisory board whose members are drawn from the scientific, educational, and business communities. The original Council guided the scientific panels and Project 2061 staff through the publication of *Science for All Americans*. As the Project entered its next phase and began to work more closely with school-district educators, the Council was reconfigured to include more teachers and school administrators. Today, the Council is made up of members of the scientific, higher education, K-12, and business communities who provide expert advice and assistance on Project 2061 activities throughout the year.

National Council on Science and Technology Education

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Project 2061 School-District Centers

Established in 1989 and located in school-district centers in San Antonio, San Francisco, San Diego, Philadelphia, rural Georgia, and suburban McFarland, Wisconsin, Project 2061's six school-district teams represent America's diverse public school system. These teams played a major role in the development of *Benchmarks for Science Literacy* and Project 2061's professional development workshops. Today, the teams set their own agendas for local reform and provide numerous workshops in their communities on Project 2061's reform tools. Their input and feedback ensure that Project 2061 activities are always grounded in the front-line experience of teaching and influenced by the diversity of our nation's schools.

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Informal Science Programs

Museums and science centers around the country have used Project 2061's tools to develop new exhibits and teacher kits.

- Investigate!, a hands-on exhibit at the Boston Museum of Science, promotes some of the scientific thinking skills described in *Science for All Americans*. Visitors step into the role of scientist and ask questions, take measurements, and interpret results of their experiments.
- Science Alive!, an interactive science center in Grand Rapids, Michigan, focuses its exhibits on four *Benchmarks* chapters: The Living Environment, The Human Organism, The Physical Setting, and The Designed World.
- The Cranbrook Institute of Science in Bloomfield Hills, Michigan, has based its new exhibits on a concept similar to Project 2061's growth-of-understanding maps, emphasizing connections among key systems such as climate, plate tectonics, and evolution.
- The Franklin Institute Science Museum in Philadelphia has revised its "Museum to Go" teacher kits using *Benchmarks for Science Literacy* to ensure that concepts are introduced at appropriate grade levels.

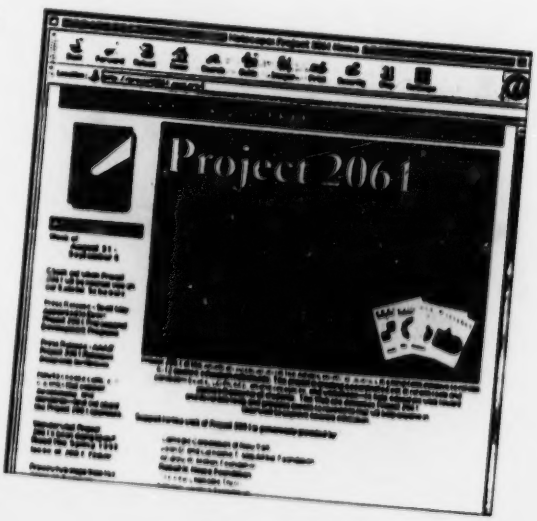
Project 2061's work has also guided the producers of such television programs as *Scientific American Frontiers* and *The New Explorers*, which have been seen in households across America.

Project 2061 Influences Community Collaboration in Oregon

Oregon elementary teacher Frank Luzaich was introduced to Project 2061 tools and resources during a two-week staff development workshop last summer. He subsequently helped his school district to develop a science curriculum framework based on Benchmarks for Science Literacy *and Oregon's state standards. When he realized that his elementary school lacked the texts and equipment needed to teach toward benchmarks, he rallied for funding and unknowingly convinced a parent during his presentation. The parent donated half the funds for a new, full K-6 curriculum for two elementary schools. Luzaich stated, "Unlike most large curriculum projects, we have been rewarded with immediate satisfaction. Elementary teachers have a new curriculum framework and new curriculum materials this year. The Project 2061 training I received produced more than a binder on the shelf. We now have science equipment and instructional materials that align well with benchmarks."*

LOOKING AHEAD. . .

Reaching the Community. To help all Americans understand the need for long-term education reform in science, mathematics, and technology, Project 2061 is expanding its communications efforts. Through television, radio, video, newspaper and magazine articles, education conferences, and the World Wide Web, Project 2061 will seek to build support for science literacy among all members of the community.



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IMAGINE A NATION WHOSE CITIZENS ARE SCIENCE LITERATE

THERE ARE NO VALID REASONS—INTELLECTUAL, SOCIAL, OR ECONOMIC—WHY THE UNITED STATES CANNOT TRANSFORM ITS SCHOOLS TO MAKE SCIENCE LITERACY POSSIBLE FOR ALL STUDENTS. WHAT IS REQUIRED IS NATIONAL COMMITMENT, DETERMINATION, AND A WILLINGNESS TO WORK TOGETHER TOWARD COMMON GOALS.

Science for All Americans

As the accomplishments and new initiatives described indicate, Project 2061's approach to science education reform is both visionary and practical. While keeping its long-term goals clearly in focus, the project aims to improve science, mathematics, and technology education in immediate, tangible ways—by helping teachers make better decisions about how and what they teach, encouraging curriculum developers to shape new textbooks around benchmarks, or showing parents how they can expand on their children's school experiences with books, museum visits, or simply a walk in the neighborhood. Much has been accomplished over the past 13 years but much remains to be done.

Significant, lasting reform will require more resources—both financial and human—more time, and, above all, more patience. But the cost of not making such investments is high. As *Science for All Americans* reminded reformers in 1989, the wisdom with which people use science and technology will, to a large extent, determine the fate of individual human beings, the nation, and the world. With its strong commitment to achieving a science-literate society, AAAS's Project 2061 will continue to work toward its goals and improve science, mathematics, and technology education for all students.

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Zucker, Andrew A., Young, Viki M., & Luczak, John. (1996). *Evaluation of the American Association for the Advancement of Science's Project 2061*. Menlo Park, CA: SRI International.

INFORMATION AND ORDERING

To order Spanish translations of Science for All Americans *or* Benchmarks for Science Literacy, *or to subscribe to our semi-annual newsletter,* 2061 Today, *please contact:*

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Science for All Americans, Benchmarks for Science Literacy, Resources for Science Literacy: Professional Development, and *Blueprints for Reform* are published by Oxford University Press. They can be ordered by mail or telephone from:

Oxford University Press, Ordering Department
2001 Evans Road , Cary, NC 27513
Telephone: 1-800-451-7556
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Blueprints for Reform, 0-19-512427-8, $17.95, paper

Science for All Americans, 0-19-506771-1, $13.95, paper

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Resources for Science Literacy: Professional Development
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Resources for Science Literacy: Professional Development* & *Benchmarks for Science Literacy, 0-19-521345-9, $70.00

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Benchmarks on Disk, Benchmarks for Science Literacy,* & *Science for All Americans
for Windows, 0-19-510328-9, $45.00
for Macintosh, 0-19-509404-2, $45.00

Project 2061 Panel Reports are available from:

AAAS Distribution Center
P.O. Box 521, Annapolis Junction, MD 20710
Telephone: 1-800-222-7809
(VISA/MasterCard only; 9 a.m.-4 p.m. EST)

Project 2061 Panel Reports: $8.00 each (AAAS members $6.50); 10-49 copies $4.00 each; 50 or more copies $3.50 each. Individuals must prepay. For institutional purchase orders, add $3.50 for postage/handling. Please specify item number and allow 2-3 weeks for delivery. For CA, add applicable sales tax; for Canada, add 7% GST.

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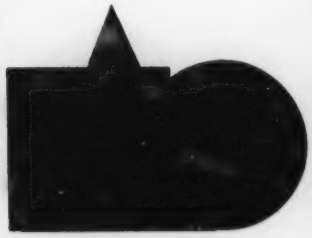
Five-volume set (#89-12Y), $35.00 (AAAS members $30.00); 10-49 sets $28.00 each; 50-99 sets $25.50 each; 100 or more $22.00 each.

SCIENCE

FOR ALL AMERICANS



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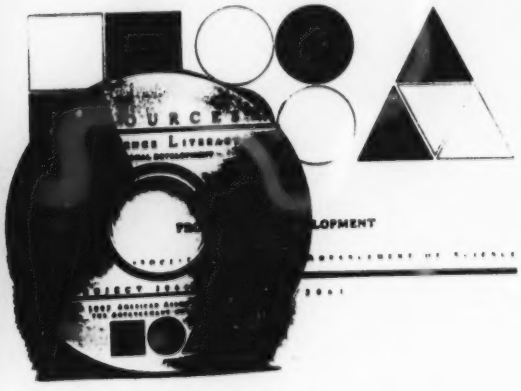
RESOURCES

FOR SCIENCE LITERACY



BENCHMARKS

FOR SCIENCE LITERACY

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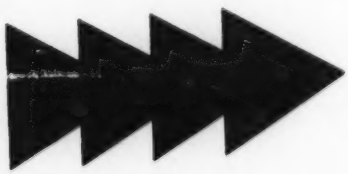

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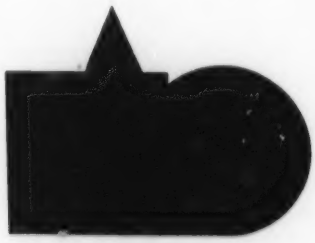

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SCIENCE, MATHEMATICS, AND TECHNOLOGY EDUCATION

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